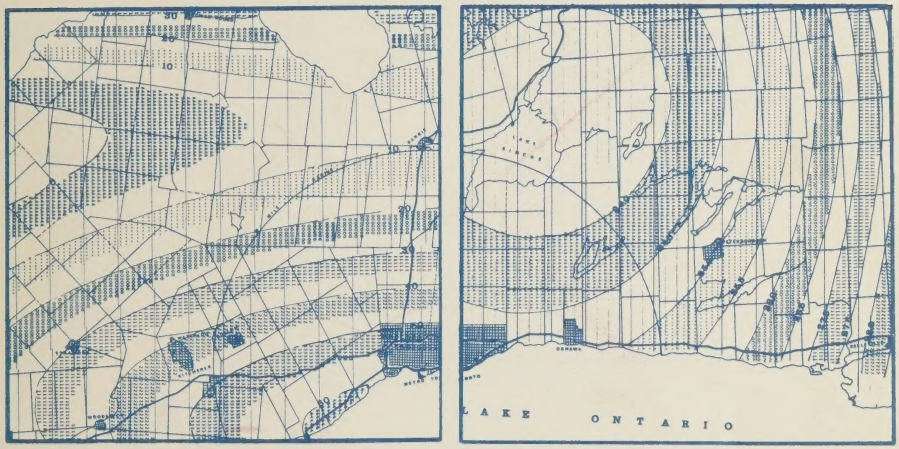
THEORY AND REALITY OF INDUSTRIAL LOCATION IN THE TORONTO REGION



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A REPORT TO THE REGIONAL DEVELOPMENT BRANCH ONTARIO DEPARTMENT OF TREASURY AND ECONOMICS

TORONTO AUGUST 1970

THEORY AND REALITY OF INDUSTRIAL LOCATION IN THE TORONTO REGION

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A Report to the Regional Development Branch
Ontario Department of Treasury and Economics

Toronto
August 1970

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

PART ONE

INTRODUCTION AND RESEARCH DESIGN

A. Is There a Rationale for Industrial Location?

Throughout Canada, the United States, indeed, throughout the world associated with concerns over economic growth is the activity of "industrial promotion". This near-ubiquitous activity has become a kind of "industry" itself. Countless pamphlets, brochures, etc. are distributed annually extolling the economic advantages of plant location in countless communities, regions, provinces, and states. Numerous seminars are held to instruct industrial development commissioners on which attributes of their communities to promote. The rationale for this widespread activity has, for several decades, been largely based on the theory that certain least-cost factors attract industry: low wage rates, land costs, transportation rates or tax rates.

But is this rationale valid? Or is it as Britton Harris has commented?

> "...it is beginning to appear that in spite of much more sophisticated work over many decades in industrial location, the problems of residential location are more tractable and amenable to sound solution."1/

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1 Britton Harris, "The Uses of Theory in the Simulation of Urban Phenomena," JOURNAL OF THE AMERICAN INSTITUTE OF PLANNERS, XXXIII, September 1966, 258-272.

This sage remark will probably bring an appreciative nod from many researchers as well as from planners and industrial development commissioners who have sought to use location theory in practical situations. For all too often it seems that location theory may be able to tell us where industry ought ideally to locate, but cannot explain locations of industry which do not fit the model.

The examples seem endless where industrial development is not played according to the least-cost rules of location theory. Nor does there seem to be any ready explanation why the same incentives programme to attract industry to equally endowed depressed areas does not produce uniform results. Neo-Weberian additions to the theory, such as juxtaposition and urbanization economies[2], help explain the latter-day success of large cities in attracting the bulk of industrial development. But not all factories locate in metropolitan areas; and not all small centres are losing their industry to the metropolis. Add to this the findings of Ruttan and Wallace that little can be done in the way of incentives to affect the three-stage location process of most firms (from region to locale to site) and it is no wonder that skepticism prevails.[3]

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2 Walter Isard and E. W. Schooler, "Industrial Complex Analysis: Agglomeration Economics and Regional Development," JOURNAL OF REGIONAL SCIENCE, Spring 1959.

3 Vernon Ruttan and L. T. Wallace, "The Effectiveness of Location Incentives on Local Economic Development," JOURNAL OF FARM ECONOMICS, 44, November 1962. For an excellent example of how this worked with regard to the decision of the Ford Motor Company to locate in St. Thomas, Ontario, see Roy F. Bennett, "Why Ford Motor Company Located Their Plant in Elgin County," An Address to the Erie Economic Council, February 22, 1969.

Further, if one asks about the possibility of industry being distributed in some regular way within and between regions, there is, with few exceptions, nothing much more to rely on than a "geography of concentration".[4/] Down at the urban region level, where so many of our planning and development concerns are, we know little about whether the "concentration" is concentrated, dispersed, or in some way regularly patterned. Does it follow the least-cost rules of location theory?

It is the contention of this paper that "hard" evidence is needed about the congruence of industrial location behaviour and industrial location theory. This paper attempted such an analysis for the Toronto metropolitan region, an area approximately 100 miles around Toronto. In general, the paper responds to the question:

> What is the degree of correspondence between the location pattern of industrial firms in the region and patterns of key least-cost factors usually presumed to influence industrial location?

Four least-cost factors were used here: wage rates, land costs, local taxes, and transport rates.

Following a description of the analytical perspective employed in the study, the results of tests of congruence between the factors and the location of industrial plants for 1967 are presented.

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4 The initial ground is well covered in Edward Ullman, "Regional Development and the Geography of Concentration," PAPERS of the Regional Science Association, 4(1958), 179-198; two important additions to the literature are D. G. Kerr and N. Field, GEOGRAPHICAL ASPECTS OF INDUSTRIAL GROWTH IN THE METROPOLITAN TORONTO REGION, A Report to the Ontario Regional Development Branch, 1968 and D. Michael Ray, MARKET POTENTIAL AND ECONOMIC SHADOW, Department of Geography, University of Chicago, Research Paper 101, 1965.

B. A Perspective For The Problem

The economic growth of any development region may, in large part, be regarded as the outcome of matching the supply of location possibilities within the region with the locational requirements of the industries that might choose the region as a place of production. The development pattern which emerges will reflect those points whose supply of location requirements most closely approximate the demands for particular locations. Typically, this pattern will occur in the matrix of urban areas.[5/]

The requirements that are economically important to the location of an industry may be called location inputs.[6/] Expressed as requirements, location inputs represent an effective demand on the part of firms seeking a location. Conversely, location inputs can be expressed, on the supply side, as location points which possess to one degree or another the possibility of satisfying the location requirements of an industry. A location surface thus represents the frequency distribution of the supply of location inputs and is the matrix for development.[7/]

A location surface might be conceived of as a relief map on which the peaks are locations possessing many location inputs of an advantageous kind

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5 A good collection of the literature impinging on this subject is found in John Friedmann and William Alonso, REGIONAL DEVELOPMENT AND PLANNING, Cambridge, MIT Press, 1965.

6 We have put aside from this discussion extra-economic factors, while still acknowledging their importance, in location decisions.

7 John Friedmann, REGIONAL DEVELOPMENT POLICY, Cambridge, MIT Press, 1966, pp. 26ff.

for industry and thereby have a high potential for industrial development. The troughs are, conversely, locations of low potential. The knowledge of a location surface for development region would be very useful for those engaged in policy formulation for economic development. It could act, initially, as a diagnostic tool to help explain the reasons for differences in development within a region. In addition, the configuration of location inputs at each point is the inventory of assets (or deficiencies) which would be needed in devising incentives' policies for industrial location.

This study sought to derive a location surface for the Toronto region for 1967. That is, to describe the pattern of location inputs for a comprehensive set of location points in the region which would represent the supply of location requirements for industry. It also sought to derive the pattern of demand for location requirements as this is reflected in actual spatial pattern of manufacturing plants in the region.[8/] Matching the supply surfaces with the demand surface would then provide the basis for speculating about our initial question, paraphrased as, are locations with the greatest supply of least-cost location requirements more likely to attract industry?

The Research Design

The 100-mile Toronto region was divided into 251 spatial units which

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8 Using the existence of a plant as a measure of the demand at that location, it is recognized, is really only a measure of performance. But, as in other researches of industrial location, no other way of measuring demand was available.

correspond to the municipal boundaries of townships and major urban centres. Each of the spatial units was assigned a set of x- and y-coordinates. The scores obtained by each of the spatial units in number of plants, wage rates, tax rates, etc. were introduced as z-coordinates at their centroids. Thus, a series of location surfaces was produced covering both the demand side and the supply side of location inputs.

The analysis consisted in fitting trend surfaces of first-, second-, and third-degree polynomials to the individual sets of xyz-coordinates.[9] Computer-generated maps of the fitted surfaces along with their statistical functions comprise the major output of the analyses. The aim, of course, was to determine whether the fitted surfaces reproduce the actual location surfaces of plant location and of least-cost factors and the degree of congruence between the demand and supply surfaces.

On the demand side of location inputs, data was gathered on the number of manufacturing establishments in the study region as of the beginning of 1967. These data were obtained mainly from two sources: the Industrial Directory of Municipal Data for 1967, published by the Ontario Department of Trade and Development, and the Dun and Bradstreet Reference Book, September 1967. The data were analyzed in the aggregate as "all plants" and in 15 industry groupings corresponding to the two-digit SIC industry types. See Table 1.

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9 A computer programme, "Trend Surface Programme in Fortran IV for the IBM 7094," prepared by Alan M. Baker, Department of Geography, University of Toronto, was utilized in this portion of the study.

TABLE 1: INDUSTRY GROUPINGS FOR WHICH TREND SURFACES WERE SOUGHT, TORONTO REGION, 1967.[10]

Z_1 = All manufacturing industries

Z_2 = Food and kindred products (SIC 20)[11]

Z_3 = Textile mill products/Apparel and Fabrics (SIC 22/23)

Z_4 = Lumber and Wood Products/Furniture and Fixtures (SIC 24/25)

Z_5 = Paper and Allied products (SIC 26)

Z_6 = Printing, Publishing and Allied Products (SIC 27)

Z_7 = Chemical/Petroleum Products (SIC 28/29)

Z_8 = Rubber Products (SIC 30)

Z_9 = Leather and Leather Products (SIC 31)

Z_{10} = Stone, Clay and Glass Products (SIC 32)

Z_{11} = Primary Metal Industries (SIC 33)

Z_{12} = Fabricated Metal Products (SIC 34)

Z_{13} = Machinery (SIC 35)

Z_{14} = Electrical Machinery (SIC 36)

Z_{15} = Transport Equip./Professional and Scientific Instruments (SIC 37/38)

Z_{16} = Miscellaneous Industries (SIC 39)

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10 Data consisted of number of establishments and was obtained from
(a) Ontario Department of Economics and Development, Trade and Industry Branch, Industrial Directory of Municipal Data, 1967; and
(b) Dun and Bradstreet, Reference Book, September, 1967.

11 SIC Code numbers are based on Standard Industrial Classification Manual, (Washington: Bureau of the Budget, 1963).

Data for the supply side of location inputs were gathered for four factors within the same set of spatial units:

a. Industrial wage rate - the average general industrial wage rate for 1966 in per hour terms:

b. Local industrial tax rate - the equalized commercial tax rate for municipalities for 1966 in dollars per thousand of assessed value;

c. Industrial land cost - the price of serviced industrial land for 1967 in dollars per acre; and

d. Transport rate to market (Toronto) - the truck transport rate for Class 85 goods on loads up to 1000 lbs. in dollar terms prevailing in 1968.

Two other trend surfaces were also generated with data comprising the absolute and the percentage change in plants between 1961 and 1966. With this additional perspective it was hoped to throw light on the influence that a history of past industrial growth has on industrial location and whether recent trends respect the location of least-cost factors.

PART TWO

PATTERNS OF INDUSTRIAL DEVELOPMENT

A. The Pattern of Plant Location - the Demand Side

By the beginning of 1967, there were just over 7,300 manufacturing plants in the 100-mile Toronto Region. In Table 2 the incidence of these plants is given in terms of the core, selected corridors, and the rest of the region. The pattern is dominated by the core, Metropolitan Toronto, with over 40 percent of all plants. Two other corridors west of Toronto account for a further 32 percent of all plants. Only 13 percent of the plants of the region are located away from any of the major corridors. This, then, is the general distribution of the phenomena which form a location surface of the demand for location inputs for industry in Southern Ontario.

In Figure 1, a contour map prepared from a computer-generated map, the actual location surface is presented. Again, it is easy to see the prominence of the metropolitan core in attracting a large number of plants as well as the strong attractiveness of other urban centres, as reflected by the peaks over most of them. Thus, the actual location surface is more of a bead-like formation than a corridor.

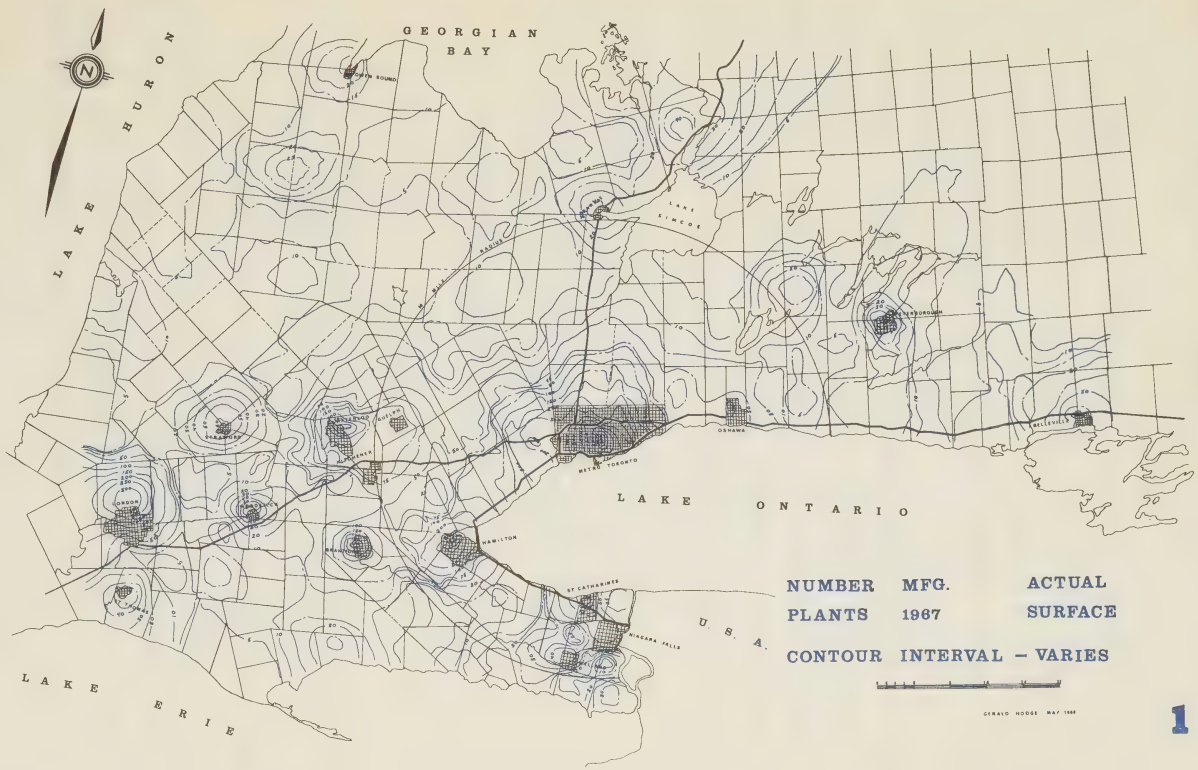
TABLE 2: DISTRIBUTION OF MANUFACTURING PLANTS IN THE TORONTO REGION, 1966

	Sector	Plants No.	Plants %
1,	Metropolitan Core	3,162	43.2
2.	Lakeshore East (Ajax to Belleville)	291	4.0
3.	Lakeshore West (Mississauga to Hamilton)	1,259	17.2
4.	401 West (Guelph to London)	1,090	14.9
5.	Niagara (Hamilton to Welland)	276	3.8
6.	Yonge North (Metro to Barrie)	271	3.7
	Sub-total Core/Corridors	6,349	86.8
7.	Remainder Region	966	13.2
	TOTAL REGION	7,315	100.0

The analytical technique employed here also has the option of obtaining a picture of plant location in mathematical terms. A set of three different three-dimensional surfaces, each with mathematical properties, are fitted to the same data as depicted for the actual surface in Figure 1. The surfaces are a first-, a second-, and a third-order polynomial. In three-dimensional terms they are linear or plane, quadric or parabolic, and cubic surfaces, respectively. Each surface is "fitted" in turn and a computer-generated map and supporting statistical data (correlations, residuals, etc.) are obtained

CENTRAL ONTARIO

INDUSTRIAL LOCATION SURFACE



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for each. Only the cubic surface, which is the most reliable representation of the actual surface is reproduced here: see Figure 2.

Surfaces were generated not only for the aggregate of all plants, but also for 15 industry groups. The statistical fits obtained for each surface are given in Table 3.

This process of surface fitting reveals a complex pattern of the location of manufacturing plants which is best described by a third-order polynomial - a cubic surface. In all cases, this more elaborate surface gives the most representative location surface. The main features of the surface depicting the aggregate of plants may be described verbally:

1. An elongated dome of intense industrial activity centred on the metropolitan core;

2. The lateral extension of the dome of highest industrial activity over the major highway corridor linking Toronto to Montreal in the east and Windsor/Detroit in the west;

3. A lesser ridge extending north from the metropolitan core generally astride the main north-south highway;

4. Sharp downward gradients of industrial activity to each side of both main highways; and

5. A second, and considerably slighter, east-west ridge over several northern centres recently the recipients of industrial location incentives.

(It is significant that this form of the location surface was generally invariant through several experiments which sought to achieve a better fit. The present coefficient of correlation, although not extremely high, is a six times improvement. It is not expected that any different pattern would emerge with increased statistical explanation.)

CENTRAL ONTARIO

INDUSTRIAL LOCATION SURFACE

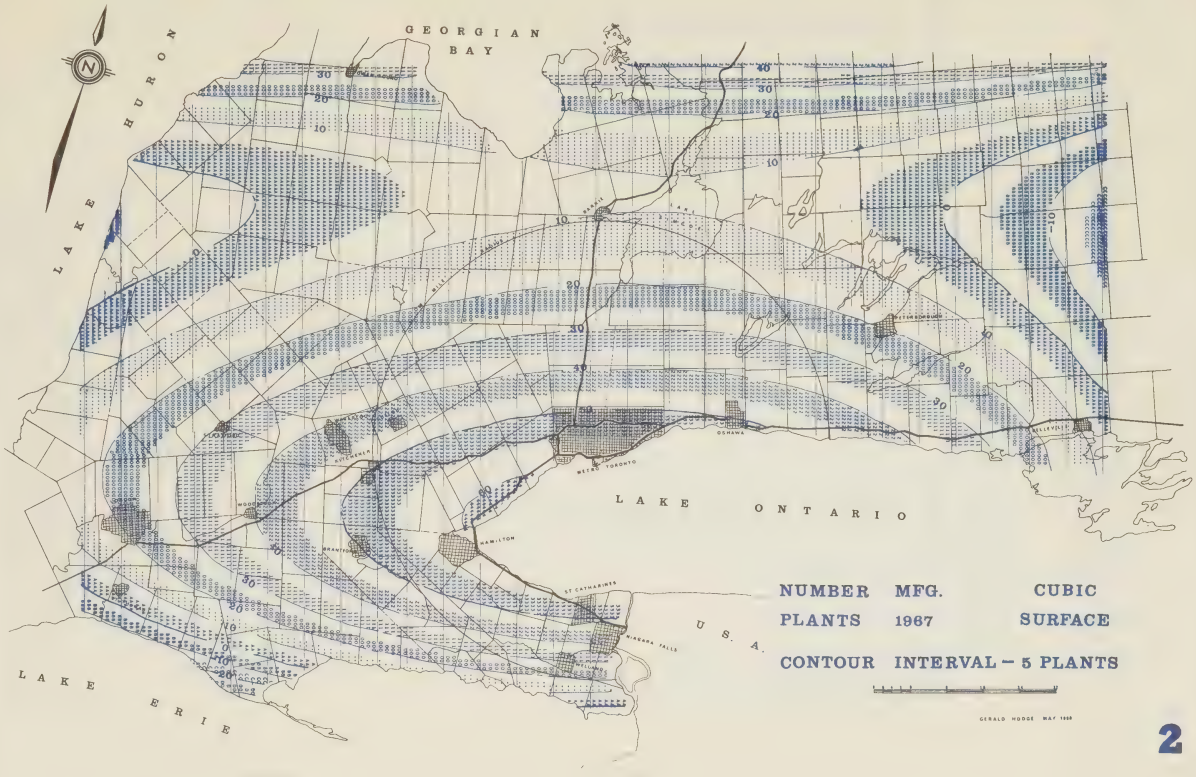

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TABLE 3: STATISTICAL FITS FOR DIFFERENT TREND SURFACES FOR NUMBER OF MANUFACTURING ESTABLISHMENTS, TORONTO REGION, 1967

Industry Group	Coefficient of Correlation Type of Trend Surface[1/] Linear	Quadratic	Cubic
All Industries	.071	.201	.493[2/]
SIC 20	.200	.247	.334
SIC 22/23	.179	.262	.365
SIC 24/25	.082	.236	.344
SIC 26	.196	.299	.399
SIC 27	.143	.201	.304
SIC 28/29	.177	.316	.401
SIC 30	.106	.320	.396
SIC 31	.111	.178	.244
SIC 32	.172	.314	.405
SIC 33	.229	.341	.425
SIC 34	.165	.334	.433
SIC 35	.147	.288	.394
SIC 36	.103	.257	.330
SIC 37/38	.108	.269	.351
SIC 39	.154	.217	.302

Notes: 1 The equations of the polynomial surfaces are:

Linear: $z = A_{1,1} + A_{1,2}x + A_{1,3}y$

Quadric: $z = A_{2,1} + A_{2,2}x + A_{2,3}y + A_{2,4}x^2 + A_{2,5}xy + A_{2,6}y^2$

Cubic: $z = A_{3,1} + A_{3,2}x + A_{3,3}y + A_{3,4}x^2 + A_{3,5}xy + A_{3,6}y^2 + A_{3,7}x^3 + A_{3,8}x^2y + A_{3,9}xy^2 + A_{3,10}y^3$

2 This fitting is the result of truncating the high values of Toronto, Hamilton, London, Mississauga, Kitchener/Waterloo, and Markham/Vaughan townships in order to obtain a more realistic fit across the small centres.

With regard to the separate industry groups, six of the fifteen have a distribution throughout the region which is not the same as the aggregate pattern. Food Products (SIC 20) firms are found widely spread across the region in all areas. Printing and Publishing (SIC 27) firms are also found widely dispersed in the region. Lumber and Wood Products/Furniture (SIC 24/25) industries are found skewed toward the northwest quadrant of the region; indeed, Kitchener-Waterloo has a larger concentration of such firms than the metropolitan core. The Leather Products (SIC 31) industry in southern Ontario is also strongly concentrated in centres west of the core. Two remaining groups, Electrical Machinery (SIC 36) and Miscellaneous Products (SIC 39) have firms which are found mainly in the largest cities of the region and only very few found elsewhere. Each of the foregoing distributions is clear from a map of residuals. They generally help to explain why a cubic surface is not a sufficiently good representation of the location surfaces for some industries.

The various location surfaces described above present the pattern of where manufacturing industries make demands for inputs. At the locations they occupy in the region, the plants require land, labour, and access to raw materials and markets (i.e., transportation). They are also obliged to pay for services in the community (local taxes). The cost of these factors can all vary by location within the region. Have the manufacturing firms in the region chosen locations where costs of some or all of the factors are least? That is, do the location surfaces of plant location coincide with patterns of lowest cost in land, labour, transportation, and taxes?

B. The Patterns of Least-Cost Location Inputs - The Supply Side

In looking at the supply side of location inputs one must decide, first, which factors affecting production costs of manufacturing firms would show differences between locations in the region. Differences in costs could affect the choice of location for a firm. Provincial taxes need not be considered because all like-firms pay the same taxes regardless of location within Ontario. But local taxes do differ between municipalities and need to be included in the analysis. Labour wage rates and land costs also differ between centres in the region and are included, too. Transport rates on raw materials or finished products are important to production firms. Since Toronto is both the main metropolitan market for the region's industries and the main distribution point for their products going to other regions, access to Toronto is essential for the region's firms.

Trend surfaces may be derived for each of the four location inputs - wage rates, land costs, local tax rates and truck transport rates - just as for the location of plants. The statistical fits of the surfaces prevailing in 1967 are given in Table 4. On three of the four factors a good fit is achieved with a cubic surface, thus reflecting a reasonable degree of regularity in their distribution in the region. The pattern for each is generally one of a distended dome or bowl centred over Toronto. Only the surface for local tax rates shows an uneven distribution. Computer-

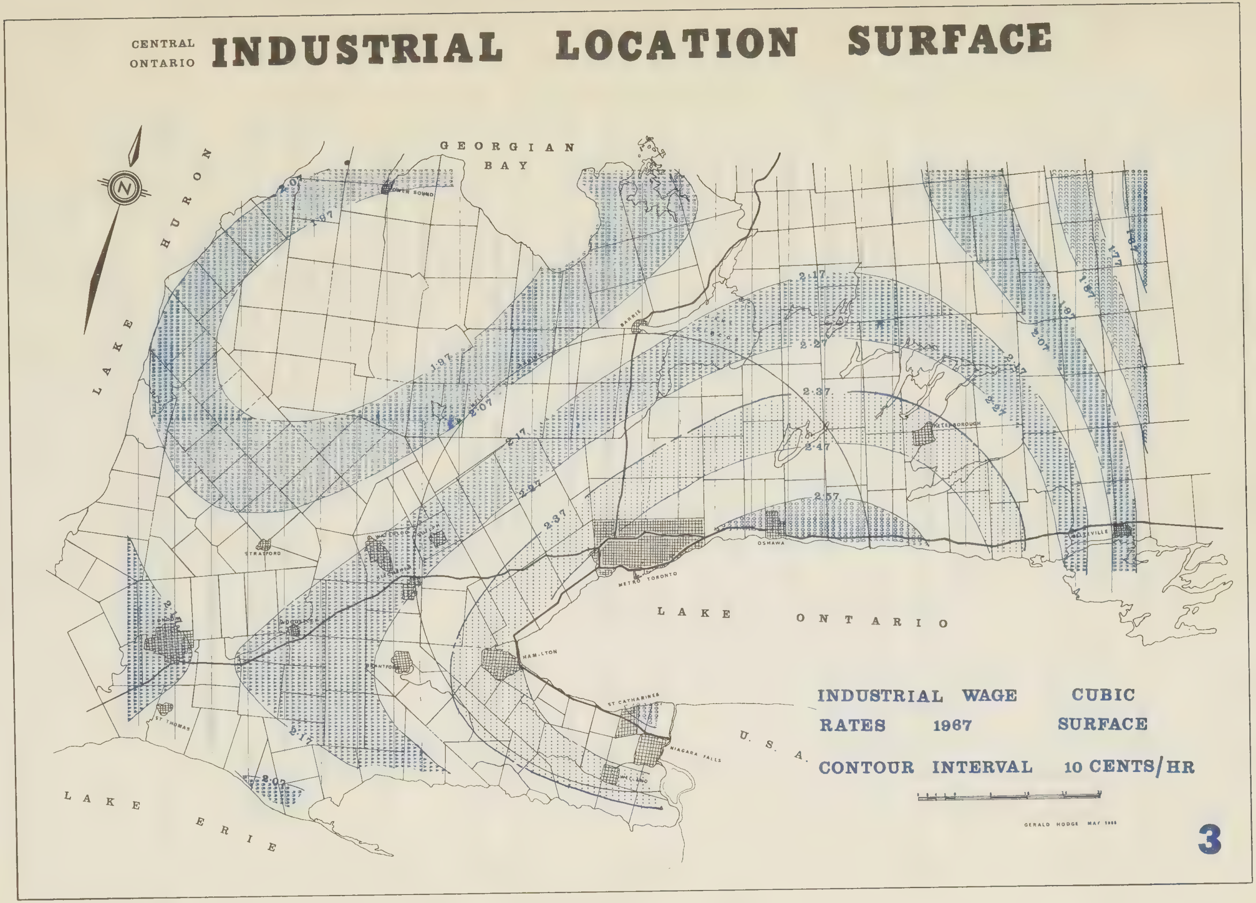
generated maps for the four surfaces are presented in Figures 3 - 6. Each of the input surfaces is described briefly below.

TABLE 4: STATISTICAL FITS FOR TREND SURFACES OF FACTORS PRESUMED TO AFFECT PLANT LOCATION, TORONTO REGION, 1967

Least-Cost Factor	Type of Trend Surface		
	Linear	Quadratic	Cubic
	(coefficient of correlation)		
Industrial Wage Rate	.376	.443	.505
Local Tax Rate	.040	.206	.236
Industrial Land Cost	.128	.438	.516
Transport Rate	.191	.704	.767

Sources: 1. Canada, Dominion Bureau of Statistics
2. Ontario, Department of Municipal Affairs
3. Municipalities involved.
4. J. T. Girvan & Associates, Toronto

Industrial Wage Rates (Figure 3). A third-order polynomial achieves a good fit with data on industrial wage rates. An irregular dome centres just east of the metropolitan core, approximately over the high-wage automotive industry city of Oshawa. A similar high level of wages is also found in St. Catharines. Wage levels drop off very quickly east of Oshawa, but the gradient is much less steep west of Toronto. The industrial centres



CENTRAL ONTARIO
INDUSTRIAL LOCATION SURFACE
GEORGIAN BAY
LAKE HURON
LAKE ONTARIO
LAKE ERIE
U. S. A.
OWEN SOUND
BARRIE
PETERBOROUGH
OSHAWA
METRO TORONTO
HAMILTON
ST CATHARINES
NIAGARA FALLS
BRANTFORD
STRATFORD
ST THOMAS
2·07
1·97
2·17
2·27
2·37
2·47
2·57
1·87
1·77
INDUSTRIAL WAGE RATES 1967
CUBIC SURFACE
CONTOUR INTERVAL 10 CENTS/HR
GERALD HODGE MAY 1968
3

of Waterloo, Brantford, Guelph, and Galt help hold up the level in the west. Centres north of Toronto such as Barrie, Owen Sound, Collingwood and Orillia which have experienced industrial development help generate a slight ridge of high wages in the north.

The trend surface for this location input - wages - is very much the same as that prevailing for the location of plants. That is, high industrial wage rates prevail in those centres which possess the industrial plants. Areas with low wage rates possess very little industry.

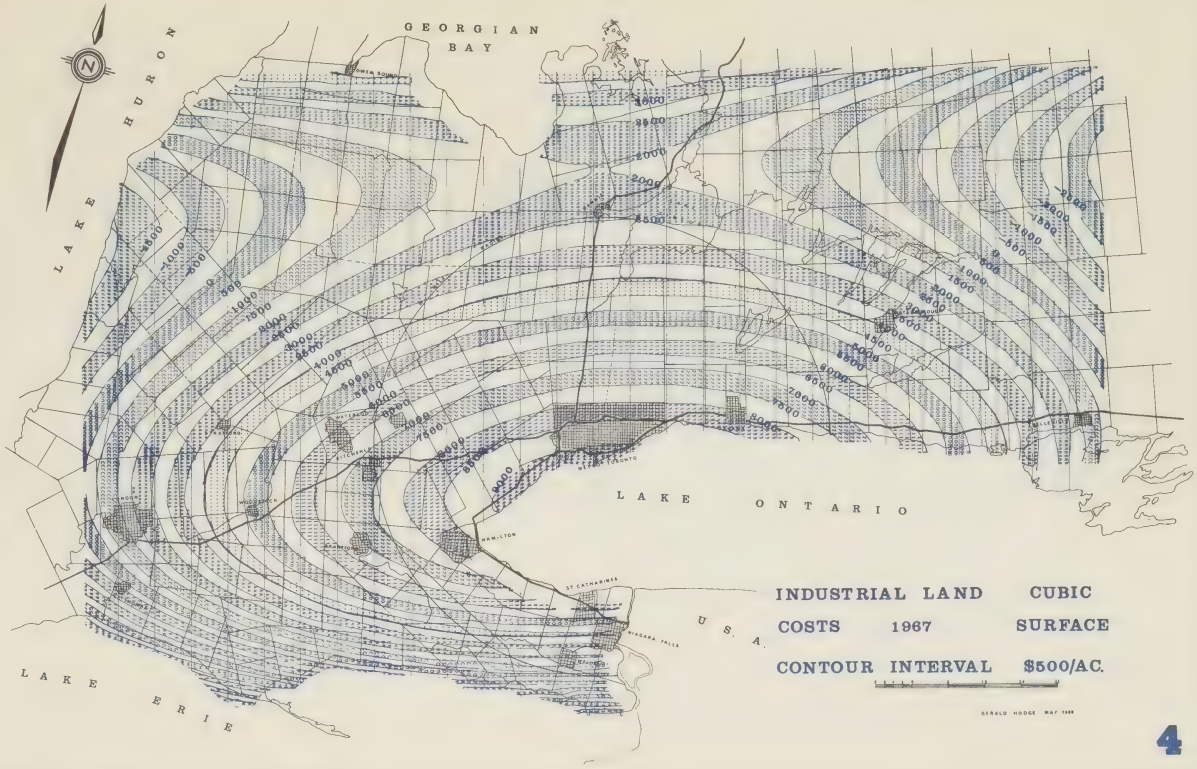
Industrial Land Costs (Figure 4). Using data on the cost per acre of industrial land, it is possible to obtain a good fit with a cubic surface over the Toronto Region. There is, again, a dome centred just over the metropolitan core. The average industrial land cost at this peak is about $31,000 per acre, while the lowest cost industrial land in the region with comparable services is twenty times less. The dome is distended east and west along the Lakeshore and Highway 401; the northward-leading saddle and the Georgian Bay ridge are apparent, as is the case with the surface of plant location.

The highest elevations of this surface represent the highest land costs that industry would have to pay within the region. The surface generally corresponds to that of the number of plants. Thus, high land costs tend to prevail at the centres chosen by industry for their locations.

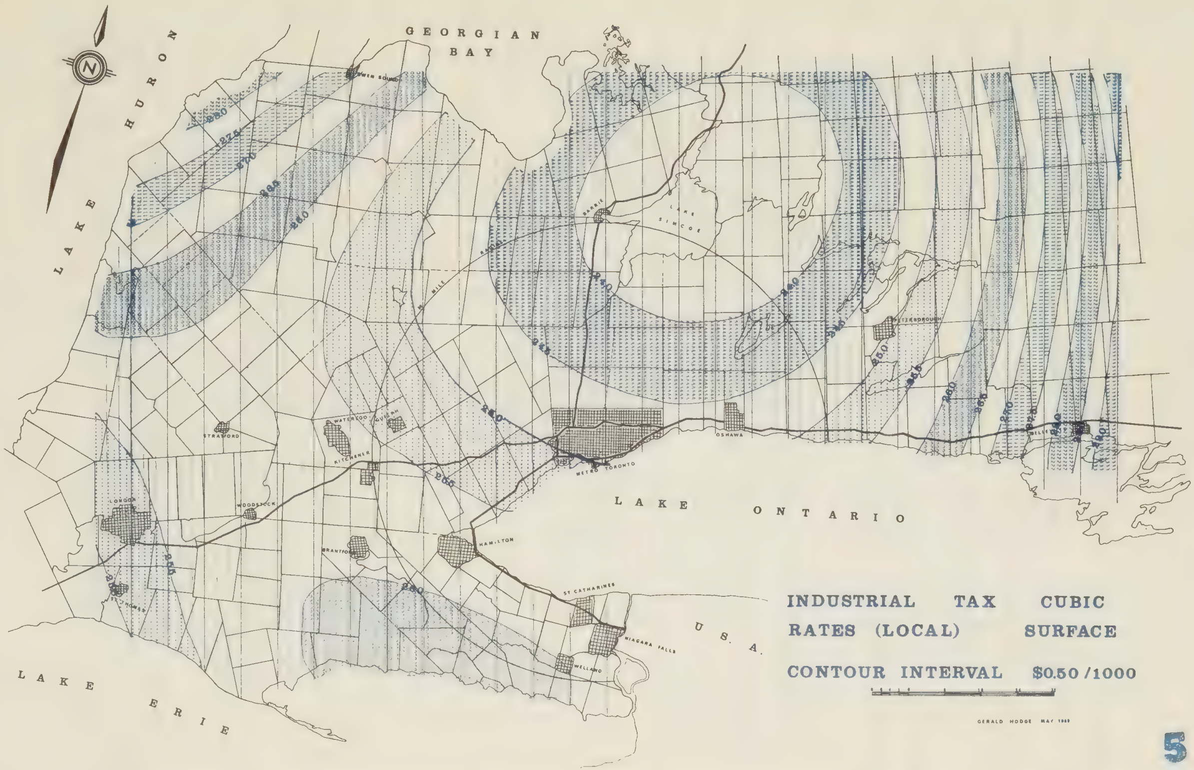
Local Tax Rates (Figure 5). This location input has the least regular pattern of the four examined. Within a range of from $13 to $36 per thousand dollars of assessed value there is a wide dispersion of rates and no dominant

CENTRAL ONTARIO

INDUSTRIAL LOCATION SURFACE



CENTRAL ONTARIO INDUSTRIAL LOCATION SURFACE



frequency. (It should be noted that all tax rates used were equalized against provincial standards to avoid local assessing biases.) The metropolitan municipality has a higher-than-median tax rate on industry, but many urban and non-urban municipalities have still higher rates. The disparate picture means that a trend surface of the degree of elaboration available to this study could not represent the distribution adequately, as the poor fit attests.

The lack of coincidence between the location surface for plants and that for local tax rates seems to point up the indifference of firms for this cost factor. This concurs with the findings of Wonnacott and others, that taxes represent one percent or less of production costs.[12/]

Transport Rates on Manufactured Goods (Figure 6). About 85 per cent of manufactured goods moving by truck transport in Ontario are grouped under the same rate and generally move in lots of less than 1,000 pounds. The rates on this class of good for the distance between all centres and Toronto are the data used for this trend surface. They provide the best fitting surface of the four factors. This is largely due to two conditions: the rates tend to vary directly and regularly by distance from Toronto and the ubiquitous road network allows a regular spatial distribution.

This surface is, however, inverted. There is a bowl rather than a

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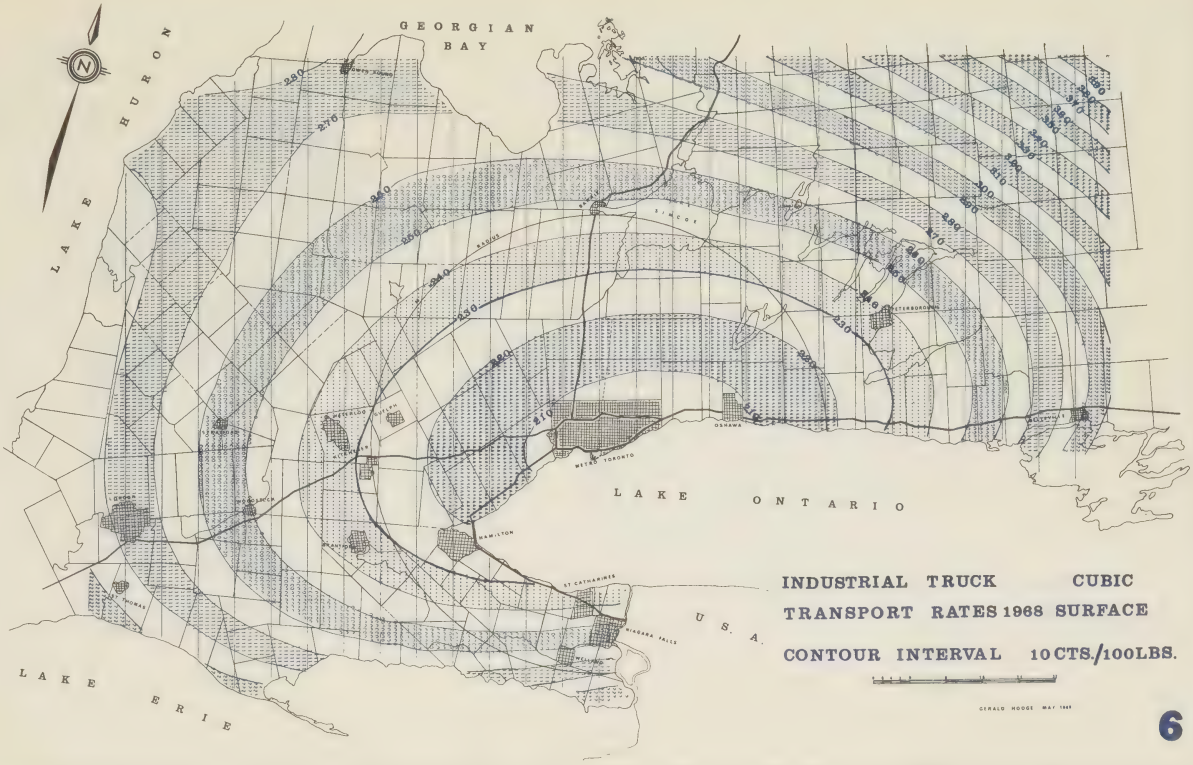
12 Ronald W. Wonnacott, MANUFACTURING COSTS AND THE COMPARATIVE ADVANTAGE IN UNITED STATES REGIONS, Minneapolis, Upper Midwest Economic Study, 1963; and William V. Williams, "A Measure of the Impact of State and Local Taxes on Industry Location," JOURNAL OF REGIONAL SCIENCE, 7 (Summer 1967), 49 - 60.

CENTRAL ONTARIO

INDUSTRIAL LOCATION SURFACE



INDUSTRIAL TRUCK TRANSPORT RATES 1968 CUBIC SURFACE

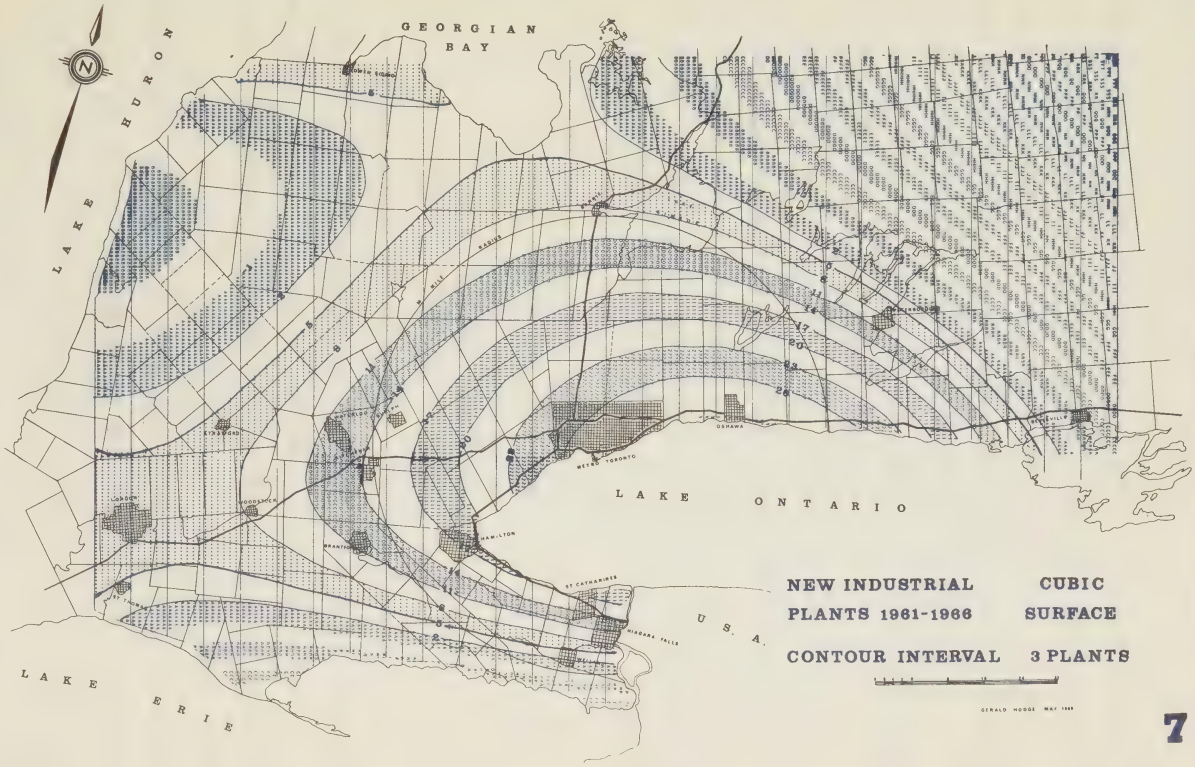
CONTOUR INTERVAL 10 CTS./100LBS.

GERALD HODGE MAY 1969

6

CENTRAL ONTARIO

INDUSTRIAL LOCATION SURFACE



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(1) number of new plants added, 1961 - 1966; and

(2) percent change in number of plants, 1961 - 1966.

During the five years 1961 - 1966, the Toronto Region experienced a nearly 11 percent growth in the number of plants (not including additions to existing plants). Table 5, using the same geographical sectors as Table 2, shows the extent of changes that occurred. The metropolitan core and the five "corridors" experienced a less than average growth rate in the period, while other areas were higher than average. This indicates a greater dispersion of plants occurring in recent years. However, the amount involved is still small compared to the total - the region beyond the core and corridors increased its proportion by less than one percent. There were also some shifts in emphasis among the corridors: Lakeshore East (Whitby, Oshawa, Bowmanville, Port Hope, etc.) grew 70 percent faster than the region as a whole; Yonge North and 401 West (Guelph, Galt, Kitchener, Woodstock, London, etc.) also grew substantially faster than other corridors.

When this data is arrayed by discrete location points and a trend surface is fitted, the cubic surface presented in Figure 7 is obtained. This surface, although not a strong fit, does reveal a picture similar to that for the total of "all plants".[13/] That is, during 1961 - 1966, manufacturing plants continued to congregate in the centres which already had industry.

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13 The linear, quadric and cubic fits obtained, respectively, were 0.08, 0.27, 0.34.

TABLE 5: CHANGES IN THE DISTRIBUTION OF MANUFACTURING PLANTS IN THE TORONTO REGION, 1961 - 1966

	Sector	1961 Plants No.	1961 Plants %	New Plants 1961-66 No.	New Plants 1961-66 Growth Rate
1.	Metropolitan Core	2,924	44.1	238	8.1
2.	Lakeshore East	248	3.8	43	17.3
3.	Lakeshore West	1,160	17.6	99	8.5
4.	401 West	969	14.7	121	12.5
5.	Niagara	248	3.8	28	11.3
6.	Yonge North	240	3.6	31	12.9
	Sub-total Core/Corridors	5,789	87.6	560	9.7
7.	Remainder Region	817	12.4	149	18.2
	TOTAL REGION	6,606	100.0	709	10.7

PART THREE

INCONGRUITIES AND IMPLICATIONS OF PLANT LOCATION

A. Comparison of Plant Location and Cost Factor

At the outset, the question was posed regarding the degree of correspondence between the location of manufacturing plants and the spatial distribution of key least-cost factors. Observations have been made in preceding sections about the seeming congruence between the pattern of plants and the prevalence of high costs where the greatest number of plants have located. These observations are largely impressionistic. For, at present, no way exists to analyze directly the similarities and/or differences between trend surfaces. Thus, while two fitted trend surfaces may appear to be similar, unless they both fit the data perfectly, there is no way of knowing whether they fit the same way for the same areas.

If the original data are used, however, correlations can be obtained for the set of location points. For any point in the region, the number of plants can be matched against the wage level or the tax rate or the land cost for that point, for example. Table 6 represents the results of such a correlation analysis.

TABLE 6: RELATIONS BETWEEN PLANT LOCATION, CHANGE IN PLANTS AND LEAST-COST FACTORS, TORONTO REGION, 1967

	Total Plants	New Plants	Wage Rates	Land Costs	Local Taxes	Transport Rates
Total Plants, 1967	1.00	(correlation coefficients)				
New Plants, 1961 - 1966	.98	1.00				
Industrial Wage Rates, 1967	.11	.11	1.00			
Land Costs, 1967	.74	.76	.33	1.00		
Local Tax Rates, 1967	.03	.03	-.02	-.16	1.00	
Transport Rates, 1967	-.24	-.44	-.44	-.70	.08	1.00

The pattern of location of manufacturing plants for the region is most closely replicated by the pattern of additions made to the stock of plants during the 1961 - 1966 period. Here the correlation is almost perfect, which seems to confirm the impression of similarity between the trend surfaces. It also points up that, for attracting industry, nothing succeeds for centre like the success in already having industry.

The next best correlation of patterns is between the number of plants and the cost of industrial land. That is, where the number of plants is high the price of industrial land is also likely to be high. The same

strong relation also prevails with growth in plants: places experiencing considerable industrial growth tend to be places with high land costs. But land costs are inversely related to transport costs for the region: land costs are least for industry where transport costs are highest. The latter is simply a reflection of the high cost of land at the core, but where accessibility is also high.

Transport rates are not closely associated in their pattern with the total number of plants. To the extent that they are the relation is inverse: the fewest plants are found where the transport costs are greatest. A much closer association exists for transport rates between both growth in plants and in wage rates. In both cases the relation is inverse.

Wage rates are also not closely related to the distribution of plant numbers. A similar low correlation exists between tax rates and number of plants. Indeed, tax rates show no affinity for any of the variables. The latter confirms the original contention that an irregular distribution persists with regard to local tax rates throughout the region.

Even though there are lacking any strong associations between the number of plants and some of the least-cost factors, such as wage rates and transport costs, does not mean that a case for a least-cost rationale is thereby made. Rather, the case must be put that plants are as likely to locate in high wage areas as low wage areas; that plants are as likely to locate in areas with high local taxes as with low taxes. Finally, there is only a slight tendency for plants to locate only where transport costs are lowest.

Thus, the accumulated evidence of this study is that industry has not located at those location points in the Toronto Region which have the best configuration of least-cost factors. Just the opposite is true for industrial land costs. And recent growth in new plants continues to occur in such a way as to emphasize locations in and around the metropolitan core and along the regional highways - the places which already have industry.

B. Comparative Advantage in a Metropolitan Region

Locational theory in regard to industry is concerned not only that firms find locations with the best combination of least-cost factors, but also that such locations offer some advantage over more costly locations. Or, put another way, substantial differences exist in each factor examined here among various parts of the Toronto Region, but

> are these differences enough to make a difference in plant location?

In Ontario, there is great interest in the high degree of concentration of industry in Metropolitan Toronto. The inventory of firms shows that over 40 percent of those in the study region, the most highly-industrialized region in the province, are in Metro. Yet this core area also shows up as having a poor combination of least-cost factors. Industrial land costs

are highest here; wage rates are nearly 60 percent higher than for locations with the lowest rate. But whether these differences and others make a difference depends upon their effect on production costs.

TABLE 7: COMPARISONS OF WAGE RATES, LAND COSTS, TAX RATES, AND TRANSPORT RATES WITH LEVELS IN METROPOLITAN TORONTO, TORONTO REGION, 1967

	1967 Metro Level	Percent Difference with Metro		
		Low	Median	High
Industrial Wage Rates	$2.37 per hour	-58	- 7	+ 48
Land Costs	$31,000 per acre	-97	-90	0
Local Taxes	$28.29 per $1000	-53	-10	+ 40
Transport Rates	$1.50 per 100#s	-13	+73	+100

Taking costs at Metro as a base of comparison for the Region, any location points with costs lower than Metro possess a "comparative advantage" over Metro. Locations with higher costs than Metro are at a "disadvantage" to the core. In Table 7, differences in the cost of the four factors are compared between Metro and (1) the lowest cost location, (2) the median value cost location, and (3) the highest cost location in the region. Negative differences indicate locations possess an advantage of that percent over costs a firm has to pay in Metro. Positive differences indicate that firms in Metro enjoy advantages of that percent over firms in other locations in the region.

But it is not just the incidence of advantages that matter; it is whether the advantages are substantial enough to affect a firm's location decision. This must be traced back through a firm's combination of production costs. A broad-scale analysis of the components of production costs was beyond the scope of this study, but some convenient analogies exist from which we can test the effect of cost differences within the region.

The following shares of total production costs attributable to the four factors may be used for comparative purposes:

Wages	18%[14]
Land	3%[15]
Taxes	1%[16]
Transport	4%[17]

Other costs such as raw materials, energy, depreciation and management make up the bulk of the remaining costs, but these are not significantly affected by location.

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14 Ontario data for 19 industry groups at the 2-digit level for 1964 showed the value of "wages and salaries" having a median of 18%; see Canada, DBS, MANUFACTURING INDUSTRIES OF CANADA, GEOGRAPHICAL DISTRIBUTION, Ottawa, 1966.

15 Overall capital use estimated as 22% and land costs represent no more than one-eighth of total capital costs. Overall capital investment is recorded in reports of Ontario, Department of Trade and Development.

16 Wonnacott, OP. CIT.

17 See, for example Gerald Hodge and Cheuk Wong, THE PROSPECTS FOR EXTENDING THE NON-FERROUS METALS INDUSTRIAL COMPLEX IN NORTHERN ONTARIO, TORONTO, 1970.

In order to determine the maximum advantage that could exist for a location in the region in comparison to Metro, the differences for low value places may be used.

1. For labour costs such a location would enjoy about 11 percent net advantage in production costs over a Metro firm (.58 x 18);
2. For land costs such a location would enjoy a 3 percent advantage (.97 x 3);
3. For local tax costs the advantage would be about 0.5 percent (.53 x 1);
4. For transport cost the advantage would be about 0.5 percent (.13 x 4).

There is no location in the region which could enjoy all these advantages. Those which have a comparative advantage over Metro in labour and land costs are some distance away from the core where they then accrue extra transport costs. The likely maximum advantage would, thus, be only about 10 percent. A location, say, 75 miles from Toronto to the northwest or northeast or along Lake Erie might enjoy such favourable terms.

If we examine the median value location (which means that half the centres are at a higher level), the comparative advantage all but disappears. While an advantage is picked up on labour (1.2%) and land (2.7%), transport rates would amount to a disadvantage of nearly the same amount (2.9%). The comparative advantage for most centres would be 1 - 2 percent or less over a Metro core location.

Indeed, as we have seen, many firms locate at higher cost locations in

the region than Metro. Extending the foregoing analysis suggests that they may suffer as much as a 13 percent net disadvantage on economic ground.

C. Do Industries Really Care About Location Costs?

Little or no industry is now situated at those locations in the Toronto Region which possess the best configurations of least-cost factors. Rather, the opposite is the case and recent growth continues to emphasize this lack of congruence with location theory.

Substantial differences in wage rates, land costs, tax rates, and transport costs do exist between location points in the Toronto Region. The fact that these differences do not make a difference to plant location could reflect two things: first, even differences of the size observed in the location inputs are not large enough to determine locations of plants on "pure economic" grounds. Yet, since these are the real differences, it means that there is an indifference to such economic factors. Second, other factors must be affecting industrial location such as "extra-economic" elements which are referred to variously as "the quality of life" or amenities. They may include such diverse variables as the climate, the quality of the educational system, cultural and recreational opportunities, and the quality of housing and other physical development.

When it is remembered that so much of our industrial development policies and programmes are built on the existence of differences in costs between core areas and peripheral areas, the implications of these findings are enormous. Peripheral areas in the Toronto region enjoying a nearly 11 percent advantage fail to attract industry. How much difference in economic terms could attract it? Further, the competition is often between places on the periphery where differences are negligible.

Consider the efforts indulged in by industrial development officials to keep land costs down. Yet even the highest priced land in the region, in Metropolitan Toronto, is equivalent to no more than one-eighth of the total capital investment in plant and equipment. That is, a plant occupying one acre of land will probably accommodate 12 employees at a capital investment of $20,000 per worker, or $240,000. At the core, land for industry is only $30,000 per acre, or less than the capital necessary for two employees. With land costs such a small proportion of costs at the core, will a further saving of $29,000 in a peripheral location really make any difference? The answer would have to be a qualified "no".

The same arguments can be made, but even stronger, with regard to efforts to lower local taxes with the aim of attracting industry. There is only a margin of one percent to work on. While wage rates, which offer the most scope for realizing a comparative advantage, are generally beyond the control of the local community.

Industrial development played in this kind of context is not even an art - it is a gamble.

The obvious predilection for manufacturing plants to locate in and around the major cities of the region and in centres on regional transport routes suggests that our theory and policy should be reformulated. Theoretically, the notions of Isard regarding urbanization and juxtaposition economies offer some escape from the dilemma. Structuring a region's development around "growth centres" and transportation linkages would seem a more realistic policy than a catch-as-catch-can incentives programme for attracting industry. But for either theory or policy about industrial location, it is vital to remember that most industrial firms are concerned with "extra-economic" factors as well as least-cost factors when making their location decisions. In metropolitan regions, the extra-economic factors seem to count most.